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Abstract

Virtual Reality (VR) to Enhance Volumetric Visualization, Contouring and Treatment Planning

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Objectives: Volumetric imaging is integral to medicine but is currently restricted to displaying 3D information on a 2D screen. Limitations of this include difficulty defining non-coplanar anatomy, inaccuracy in contouring due to interpolation and an increasing need for users to mentally create 3D models as treatments become more complex and non-coplanar. We set out to develop a way to improve the speed and accuracy of the visualization, contouring and treatment planning by creating a VR imaging platform.

Methods: We developed a software application using C# and the Unity Engine for use with a commercially available 6-degree of freedom virtual reality head mounted display and tracked hand controllers. The user can view and manipulate medical imaging imported in the standard DICOM imaging format. Different "clip objects" including a cube, a sphere and a plane allow the user to view inside the volume in any representation. Contours can be created in real time using a set of contouring tools including a 2D and 3D brush. Finally, treatment plans can in imported and viewed. Treatment plan delivery can be simply simulated using a linear accelerator model with the patient's anatomy obtained from simulation CT. Collisions can be detected with this approach.

Results: We present an early version of our VR planning and visualization application. We have successfully used the application to allow users to manipulate and contour a wide range of medical imaging including an MRI brain, CT neck, CT chest/abdomen and pelvis and CT thigh (http://dicomvr.com/intro/, http://dicomvr.com/visualization/). For demonstration, we have imported a complex brain SRS retreatment plan to allow for easy localization of prior retreatment sites which could potentially be used to select optimal beam angles for the next lines of treatment (http://dicomvr.com/contouring/). Additionally, we show a case of a thigh sarcoma neoadjuvant treatment using a linear accelerator model for treatment design and collision check (http://dicomvr.com/planning/).

Conclusions: Virtual reality can enhance visualization, contouring and treatment planning and is feasible with currently available hardware. Future study is needed to quantify the degree of increased accuracy and speed that this platform could provide.

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